Gaseous Combustion at High Pressures.

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(Abstract.)

The paper gives an account of investigations on gaseous combustion under high pressures carried out in the Fuel Department of the University of Leeds during the years 1906–12, with a special installation of apparatus, the cost of which was defrayed out of grants made from time to time by the Government Grant Committee.

Experiments in which mixtures of methane with less than its own volume of oxygen were exploded in steel bombs at initial pressures of between 8 and 32 atmospheres have given results in harmony with the "hydroxylation" theory of hydrocarbon combustion put forward some years ago by Prof. Bone. The influence of various secondary reactions upon the products of the primary oxidation whilst the gases are cooling down after the attainment of maximum pressure is discussed in the light of the experimental results.

Results of experiments upon an equimolecular mixture of ethane and oxygen, whose behaviour is crucial in respect of the different views of hydrocarbon combustion advanced in recent years, have again confirmed the hydroxylation theory. Another section of the paper deals with an experimental determination of the relative affinities of methane, hydrogen, and carbon monoxide for oxygen in flames. It is shown (1) that the affinity of methane is at least twenty times as great as that of hydrogen, and (2) that when mixtures corresponding to $CH_4+O_2+xH_2$ are fired under high initial pressures, in which the partial pressures of methane and oxygen are kept constant and x only varied, the distribution of oxygen between the methane and hydrogen varies with x^2, a circumstance which means that hydrogen is burnt *directly* to steam in flames as the result of the trimolecular change $2H_2+O_2 = 2H_2O$, and not (as some have supposed) *indirectly* through hydrogen peroxide.

The affinity of carbon monoxide is shown to be comparable with that of hydrogen for oxygen in flames. Experiments are also described in which mixtures of ethylene, oxygen, and hydrogen, corresponding to $C_2H_4+O_2+xH_2$,

were exploded at high initial pressures; *inter alia* it was found possible to increase x up to 8 without causing any deposition of carbon on explosion. The theoretical bearing of the results is fully discussed.

The final section of the paper describes experiments in which the whole pressure curves, up to and far beyond the attainment of maximum pressure, were recorded when mixtures corresponding to (1) $2H_2+O_2+4N_2$, (2) $2CO+O_2+4N_2$, and (3) $CH_4+O_2+4N_2$, are exploded under initial pressure of about 50 atmospheres. It is shown that the rates of attainment of maximum pressure in each case have no direct relation to the order of affinities of the various gases for oxygen.

Electrical Effects accompanying the Decomposition of Organic Compounds. II.—Ionisation of the Gases produced during Fermentation.

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It is well known that the gases liberated during certain chemical actions carry charges of electricity. Thus Lavoisier and Laplace found that the hydrogen liberated from the action of hydrochloric acid upon iron is charged positively. More recently Enright (1) has noted the same effect, and Townsend (2) has shown that the gases liberated during electrolysis are also charged. In a previous paper (3) evidence has been brought forward to show that the decomposition of organic matter gives rise to electrical effects which are of the same nature as those produced by the action of acids upon metals. It seemed therefore an interesting point to investigate whether the CO_2 escaping from the fermentation of a saccharine solution might carry an electric charge and be ionised.

To determine this point a series of experiments were carried out by the employment of a gold leaf electroscope and a Dolezalek electrometer. The method adopted was to suspend a metal plate with rolled edge a few centimetres above the surface of glucose undergoing fermentation through the action of yeast, the metal plate being connected with the electroscope or electrometer, and the whole suitably screened in a box lined with tinfoil. Readings were then taken in the ordinary manner.